APPENDIX D
REVIEW OF CSO STORAGE FACILITIES

Henderson/M. L. King CSO Project
Predesign Letter Report
CSO Experience at Other Facilities
Prepared by Smith Culp Consulting
November 1997

The Rouge River National Wet Weather Demonstration Program
Inkster Retention Basin
Prepared by Wayne County, Michigan
Printed November, 1999

Lessons Learned From Operation and Maintenance of
Combined Sewer Overflow Detention Basins
Water Environment Federation, WEFTEC ’99 Proceedings
October 1999

Rouge River National Wet Weather Demonstration Project
CSO Basin Evaluation Plans
Data Collection and Transfer Guide
Prepared by Wayne County, Michigan
August 1999

PREDESIGN LETTER REPORT

PREPARED BY: Gordon Culp, Smith Culp Consulting

TITLE: CSO experience at other facilities

DATE: November 26, 1997

Michigan Projects

The current “hot bed” of activity in testing and demonstrating various methods of treatment and storage of CSO is in Michigan in the Rouge River (Detroit area) Basin of Michigan. The Rouge River Program has received several hundred millions of dollars in Federal grants to demonstrate CSO treatment methods and several large projects have been or are being built. Although not all are yet in operation, their design data are of interest. All use sodium hypochlorite for disinfection and are designed for a dosage of 10 mg/L. They are all required to discharge no more than 1 mg/L chlorine residual and all have a goal of fecal coliform of no more than 400/100ml. They are generally designed for a 1 year, 1 hour storm although two (Dearborn Tunnel and Dearborn Heights) are designed for a 10 year, 1 hour storm. The major design features are summarized below. The estimated dates of completion are shown in the facility column.

Facility	Peak flow (mgd)	Description	Max Overflow rate	Cleaning
Redford (in operation as of 6/97)	123	1.5” screen, 35’ dia. Swirl, 2 rect. basins 180’x66’x11.2’	5180 gpd/sq. ft.	Tipping buckets, 2% slope, 100 gals./tip/ft. of wall
Inkster (in operation as of 6/97)	147	1.5” screen, 2 rect. Basins, 186’x60’x11.75’	6600 gpd/sq.ft.	Tipping buckets, 2% slope, 100 gals./tip/ft. of wall
Acacia Park (in operation as of 8/97)	212	2 rect. Basins , 160’x80’x20’, ¾” effluent screens	7500 gpd/sq. ft.	Flushing troughs using industrial water
Bloomfield Village (in operation as of 10/97)	494	3 rect. Basins, 157.7’x128.5’x20’effluent screens	6760 gpd/sq.ft.	Flushing troughs using industrial water
Dearborn Heights (in operation as of 10/97)	131	1.5” screen, 3 rect. Basins, 175”x60’x11.6’	4200 gpd/sq.ft.	Tipping buckets, 2% slope, 100 gals./tip/ft. of wall
Birmingham (1/98)	310	2 rect. Basins, 140’x120’x20’, ¾” effluent screens	7856 gpd/sq.ft.	Flushing troughs using industrial water
Hubbell Southfield (12/98)	775	1.5” screen, 2 rect. Basins, 900’x240’x16.5’	4000 gpd/sq.ft.	Flushing nozzles, 20 flushing areas per tank, 5000 gpm/flushing area
Puritan/Fenkell	426	½” screen, 2 rect.	9,979 gpd/sq.ft.	Tipping buckets, 7

(7/97)		Basins, 236'x99.5'x8'		flushing tanks per basin, hose bibbs for added washing
Seven Mile (11/97)	103	½" screen, 2 rect. Basins, 200'x91.5'x8'	2800 gpd/sq.ft.	Tipping buckets, 6 flushing tanks per basin, hose bibbs for added washing
Dearborn Tunnel	30 min. detention of 10 yr, 1 hr storm; complete retention of 1 yr, 1 hr storm	Bar screens, 18' dia. Tunnel x 11,400', 50'dia. X 190' deep sed chamber at end of tunnel		Min velocity of 3 fps, water stored for flushing, flushing gate opens 1'/minute

The Dearborn Tunnel project was originally planned to be a deep tunnel in rock. Groundwater investigations have caused the original design concept to be scrapped and the tunnel is being redesigned at a higher elevation in soft soils.

Data are being collected to evaluate the treatment effectiveness of the different basins as they go into service. For those basins in service, no evaluation of efficiency data is yet available. The first release of operating data is expected in January, 1998 and will be published in the WERF publication *Wet Weather RX*.

In addition to the above projects, Wayne County has four other CSO tanks that have been in service for several years ranging in volume from 2 million gallons to 19 million gallons. The projects all involve pumping into the CSO facilities and gravity flow out. Wayne County has been using vertical turbine pumps for CSO for 20 years in some cases with very good results. They are very pleased with Cascade vertical turbine pumps for this application. The pumps are preceded by mechanically cleaned screens with opening ½ the size of the solids that can be passed by the pump. They use stainless steel impellers which are easier to repair than cast impellers.

The O&M staff likes the sequential filling procedure because it minimizes cleaning in small storms. They wished that they had some smaller pumps for handling smaller storms. Their pumps are sized for the design storm and do not operate efficiently in the smaller storms.

Chlorine of the intermittent and highly variable flows has been a challenge. They are attempting to meet their chlorine residual discharge limit by controlling the chlorine dose rather than dechlorinating. Their fecal coliform removals have been variable. They have fed up to 20 mg/L of chlorine in the first basin within a CSO storage basin.

Reportedly, the tipping bucket method of cleaning has proven satisfactory so long as the basin length is not excessive in proportion to the number of buckets. The O&M staff prefers the tipping buckets to spray systems. They feel the buckets do a better job of cleaning and use less water to do it. For small storms, they sometimes have to flush the basin twice. Although the flushing gate concept is not yet in operation in the Michigan facilities, it has worked well in Canada and Europe. Water is retained in a chamber at the inlet end of the basin behind a wall of about five foot height in a 20 foot deep tank. When the rest of the tank has drained, a gate in the wall opens and releases the water to flush out remaining sediments.

All of the CSO facilities are covered with the surface used for basketball courts, soccer fields, golf courses or walk through parks. They have wet scrubbers for odor control but have not found it necessary to run the systems. They operate the fans on the basins only about 10 minutes per month.

They have not had corrosion problems in their older basins. They use titanium coated metals and a lot of plastic materials on interior of their basins to avoid corrosion problems.
Should King County and/or HDR staff want to tour the above facilities, contacts to arrange such a tour are: Rouge River Program Office: Vyto Kaunelis (313-224-3632) , Kelly Cave (313-961-0700), or Jim Murray, Executive Director; and Gary Fujita, the Detroit Water and Sewerage Department (313-224-4752).

Other Projects In Planning, Construction or Start-Up

Columbus, Georgia has constructed a CSO treatment facility that consists of coarse screens, 6-32 foot diameter vortex separators with ability to achieve dissolved air flotation and chemical coagulation within the vortex units, high-rate compressed media filtration, medium pressure ultra-violet disinfection and chlorination-dechlorination. The basins can be operated as flow-through or fill and treat units. A two-year testing program began in July, 1996. Chemical disinfection effectiveness is reportedly limited by the wide variations in chemical demand during a storm event.

Cincinnati, Ohio is constructing a 43 foot diameter Fluid Sep vortex separator preceded by a first flush tank.

The Northeast Ohio Regional Sewer District is designing a 20 foot diameter storage/conveyance tunnel for the Mill Creek Watershed.

New York City is constructing an underground 400 mgd vortex separator facility at Corona Avenue with three parallel types of units: USEPA swirl, German Fluid Sep, and UK Storm King. They are also constructing a 28.5 million gallon underground storage/treatment facility at Flushing Meadow/Corona Park scheduled to be in operation in 2001. The facility consists of 2 trains of 7 sequentially-filled basins in each train. The maximum throughput will be 1,400 mgd. Two cleaning systems are being tested: tipping buckets and hydroself. Wet scrubbers are being provided for odor control.

One of the difficulties is that many CSO treatment facilities, as is the case in the above Michigan and other projects, are only now being built or placed in operation. So, I have summarized experiences at some facilities that have been in operation for a significant period of time in the following paragraphs.

Sacramento, California

The City of Sacramento sends its dry weather flow to a regional wastewater plant. When flows exceed 60 mgd, the excess flows are sent to the City's former primary treatment plant that now serves as a CSO treatment facility. The CSO treatment facility provides primary treatment, chlorination (sodium hypochlorite) and dechlorination (sodium bisulfite) of 130 mgd. The CSO treatment plant has 3 full time staff that maintain the rectangular, mechanically cleaned clarifiers and disinfection system. During storms, two more staff assist in operation and perform the required sampling of the Sacramento River during the storm. Flows enter the CSO treatment plant about 22 times per year with overflows from the plant occurring about 10 times per year. Sludge and scum from the CSO plant is transferred to the regional plant during the storm. The tanks are drained to the regional plant after each storm and are cleaned using the scrapers in the tanks. The tanks are uncovered. In the summer, the tanks are thoroughly cleaned using a crew of five. The flights are propped up on blocks so sediment can be flushed underneath them. Two people are in the tanks with hoses flushing sediment toward the inlet end, two are on top of the tanks with hoses that keep the sediment moving, and one operates the sludge pumps.

When flows exceed 130 mgd, the excess flows are pumped to a 23 million gallon, 3.5 acre CSO storage facility, Pioneer Reservoir, which has been in operation for 20 years. A 10 foot diameter, 8,800 foot long interceptor feeding Pioneer Reservoir provides another 5 million gallons of storage. After the storm subsides, flows are returned by gravity through the same interceptor to the regional plant.

Two pumping stations that transfer flow to Pioneer Reservoir have capacities of 130 mgd and 530 mgd. The larger of the pumping stations is being upgraded to 740 mgd capacity. And 8000 kw of standby engine-generator capacity is being installed. Manually cleaned screens have been used in the pumping stations but are being replaced by mechanically cleaned climber screens. Keeping the manually cleaned screens free of debris has been very labor intensive, especially during the first flush. As many as five staff have been needed to keep the screens clean at the larger of the two pumping stations. When overflowing, the Reservoir has a hydraulic limitation of 350 mgd. At an overflow rate of 1500 gpd/sq.ft. (the design rate for the City's CSO treatment plant), the total area of Pioneer Reservoir equates to a 237 mgd capacity.

Pioneer Reservoir has three basins that are normally operated in series. The basins can be operated in parallel to reduce the headloss through the basins and allow higher flows to be pumped through them. During smaller storms and with the normal sequential operation, only the first or first and second basins are filled, reducing cleaning requirements. The City has found that

80-90% of the sediment is trapped in the first basin. A grit trap exists in the inlet structure and was recently cleaned with a bobcat and trip bucket. The concept was that the grit basin would be scoured by water returning from the Reservoir through the influent pipeline after the storm subsides but manual cleaning has been required.

The City has analyzed the treatment provided by the Reservoir when overflowing for 88 storms from January, 1992 through January, 1997. On the average, Pioneer Reservoir reduced the influent suspended solids from 103 mg/L to 53 mg/L (42% removal) and settleable solids from 1.8 ml/L to 0.1 ml/L (86% removal). There are significant variations in performance from storm to storm. On a total annual mass basis, the removal of suspended solids approached 50%. The overflow rate in the Reservoir averaged 1100 gpd/sq. ft. with a peak rate of 3260 gpd/sq.ft. The treatment performance of the storage reservoir is similar to the combined wastewater treatment plant. By adding chlorination (sodium hypochlorite) and dechlorination (sodium bisulfite), the State will accept the Reservoir as a primary treatment device. The City is currently installing the disinfection system and expects to place it in operation in February, 1998. Hypochlorite will be injected at the inlet and outlet of each section of the Reservoir. Bisulfite will be injected into the outfall to the Sacramento River.

The Reservoir was first equipped with fixed jets for washdown after a storm. One set of fixed jets was designed to flush the walls and a second set of jets was designed to flush the floors. The fixed jets did not perform well and have been replaced with water cannons which work well. The City feels that the walls have stayed clean without the use of the wall jets. Water is pumped from the adjacent Sacramento River for wash water.

The City has recently constructed an additional CSO storage tank (42^{nd} Street project). The tank has 1.4 million gallon capacity and was constructed at a cost of about $4,000,000 which includes about $400,000 for utility relocation. The rectangular (38 ft x 450 ft x 22ft deep) tank is located beneath a street in a residential neighborhood. The tank has a longitudinal wall that divides the tank into two sections that fill sequentially. After the storm subsides, the tank contents are pumped into the interceptor system by two submersible pumps located in a sump at the inlet end of the tank. The tank is cleaned using Vactor trucks. A manhole at mid-length and one at the outlet end provide access for the Vactor truck suction. There are no internal spray nozzles in the tank. The City had hoped to clean the tank with Vactor access only from the outlet end. It has proven necessary to access the tank at midpoint as well. The lack of level ground around the midpoint manhole has caused problems with Vactor access. Once per year the City staff uses high pressure hoses to flush the tank to the inlet end for a thorough cleaning.

The CSO storage facilities are unstaffed. Activated carbon is used for odor control. The odor control system at the 42^{nd} Street tank is operated a few hours each day and can provide up to 12 air changes per hour for the storage tank. Up to 4400 cfm can pass through the carbon system. A carbon system bypass has a capacity of 7680 cfm. The odor control system at Pioneer Reservoir is operated continuously. The carbon is housed in truck trailers that are hauled in and out as the carbon becomes spent. Galvanized metal within Pioneer Reservoir has held up well for 20 years. This fact is attributed by the City to the movement of air through the basins.

Saginaw, Michigan

The City provides primary treatment of CSO in a 3.6 million gallon tank (1500 gpd/sq.ft. overflow rate) that was placed in service in late 1970s. Hypochlorite is used to prechlorinate ahead of the settling tank. No screens or grit removal is provided. The only treatment requirement has been a fecal coliform of 200/100 ml, which requires 7-8 mg/L of prechlorination. The plant discharges to the Saginaw River. The facility is located in a downtown area and is completely enclosed under a parking facility. The pump stations crews check the facility and there are no on-site operators. After a storm subsides, the tank contents drain back into the sewer system. A crew of 2 spends about ½ day cleaning up the basin by using hoses and in-basin flushing nozzles. Carbon scrubbers were provided for odor control but proved ineffective and are no longer in use. They have found that prompt flushing minimizes odors.

New York City

New York has operated the Spring Creek CSO facility (six parallel basins, each 376 feet long by 50 feet wide) since the mid-1970's. It is New York City's only CSO facility. Although flow enters the units about 100 times per year, they fill to the point of overflow only about 10-15 times per year. The plant discharges to tidal waters and the stored water goes to the 26th Ward plant for treatment. No screening is provided ahead of the units. They recommend avoiding screening prior to settling because large debris can be removed at leisure from the settling basins but would require immediate attention if retained on a screen. Automated operation was planned but maintenance problems resulted in full-time staffing by six personnel. They have had difficulty pacing the chlorine feed. Sludge is removed by travelling bridges with sprays that wash out retained solids. They have had corrosion problems with the spray system.

San Francisco

Flows in excess of the main plant capacity are stored in large, upstream storage facilities. When the storage fills, flow goes to an old (1951) primary plant which is now used only for CSO treatment. The storage overflows to the treatment plant about 26 times per year. The primary plant has a capacity of 150-180 mgd and was converted to CSO treatment in 1981-82. The plant has treated CSO at overflow rates of 3000 gpd/sq.ft. and produces TSS of 40-60 mg/L, about 100 mg/L BOD. The plant discharges about 4.5 miles offshore in 80 feet of water. During the rainy season, the plant is staffed with 1-2 people around the clock. In the dry season, there is daytime maintenance only. They have found that the upstream storage is self-cleaning in regard to rags and sand. It is sloped at 2 feet/1000 feet. They have had no significant problems with the facility.

Johnson County, Kansas

The county has four CSO treatment plants, all located underground, ranging in capacity from 8 to 20 mgd. Three of the plants use rectangular basins and one uses a circular basin. They were placed in operation about 1970. Grit, rags and solids are all returned to the collection system because they do not want to haul them through the residential neighborhoods where these facilities are located. The basins operate at about 2500 gpd/sq.ft. and are about 7 feet deep. The plants discharge to intermittent streams. The plants are checked once per day with about 15 minutes spent per visit to see if any water has entered the plants and to check the hypochlorite systems. When the plants are in operation, pump and scraper operation is monitored. After each use, the basins are hosed down by maintenance crews to remove debris not collected by the scrapers. They had some problems with rags and had to enlarge the lines which return sludge from the basins to the sewers.

Decatur, Illinois

The plant, a vortex separator, was placed in service in 1987. A mechanically cleaned screen and a holding tank for the first flush which is aerated precede the vortex separator. Two-three people spend about ½ day hosing down the units with 100 psi fire hoses. They have achieved about 20% BOD removal but removal is erratic near the design rate. I spoke with the designer and he states that the facility has performed well over the last 10 years. They have received more grit at the facility than anticipated. They return the grit to the interceptor. Next time, he said he would classify and dispose of the grit at the CSO facility rather than reinject into the interceptor. There have been no odor problems.

Rouge River
National
Wet Weather
Demonstration
Project

- General Information
- Local Community Information
- Products & Data
- Contact Us
- Technical Information
- Water Quality Issues
- Getting Involved
- Current Restoration Projects
- Wildlife & Recreation
- Events Calendar
- Related Internet Sites
- Search
- Students & Teachers

Inkster
Retention Basin

Objective

The Inkster CSO project seeks to control CSO discharges and to protect water quality for public health.

Basin under construction

Owner

City of Inkster, Michigan

Location

Inkster Rd., north of Michigan Avenue. The receiving water is the Lower Rouge River.

Important Dates

Planning Start Date	October 1992
Design Start Date	May 1993
Construction Start Date	August 1994
Operation Start Date	January 1997

Construction Cost

$17,000,000, Basin only
$19,000,000, Basin and collector sewer

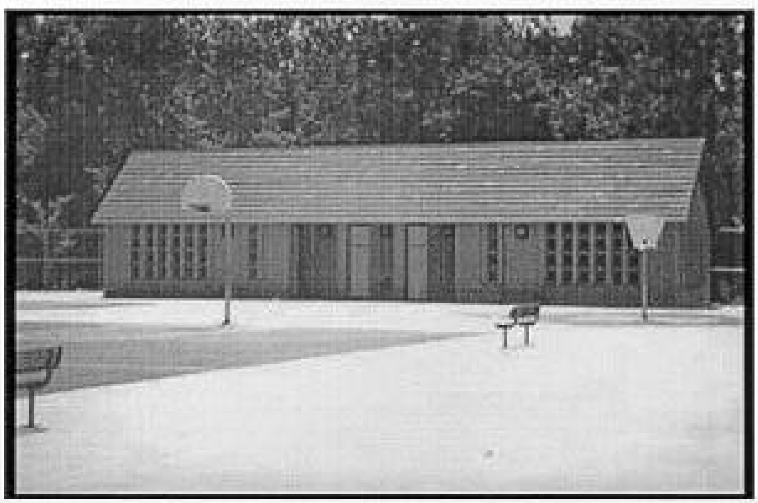
Demonstration Aspects

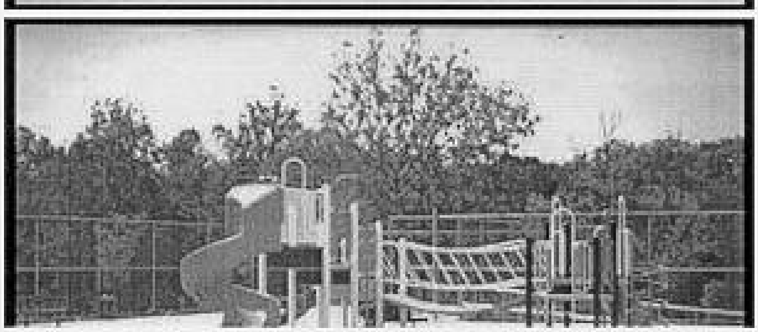
$19,000,000. Basin and collector sewer

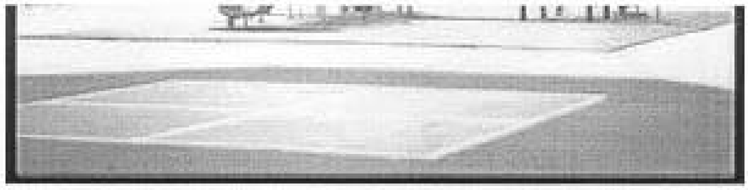
- Design for the 1 year/1 hour storm event as opposed to the presumptive 10 year/1 hour event.
- 1.1 million gallon first flush tank. When the first flush tank is full any additional flow is diverted to the 2 million gallon 2 compartment main storage basin. There is no flow-through capability for the first flush tank, its contents are dewatered to the sewer system following the storm event. Both compartments can dewater in 18 to 24 hours.
- Multiple use recreation facilities (basketball courts and playground equipment) on top of storage tank.
- Tipping bucket flushing system.
- An extensive monitoring program to demonstrate basin performance.

Project Highlights

- Serves an area of 833 acres
- Eliminates 10 CSO outfalls
- Six 45,000 gpm at 30 feet TDH, constant speed pumps
- Sodium hypochlorite disinfection system designed for 10 mg/l feed rate and 1 mg/l target residual for a peak flow rate of treated effluent of 500 cfs; space provided for addition of dechlorination facilities in the future.
- 3/4-inch mechanical screens with 1.5 inch bar spacing on the influent and skimming baffle for floatables control at the effluent
- Peak overflow rate of 6,600 gpd/sq. ft.
- Wet scrubber odor control system







Completed Basin

Major Elements

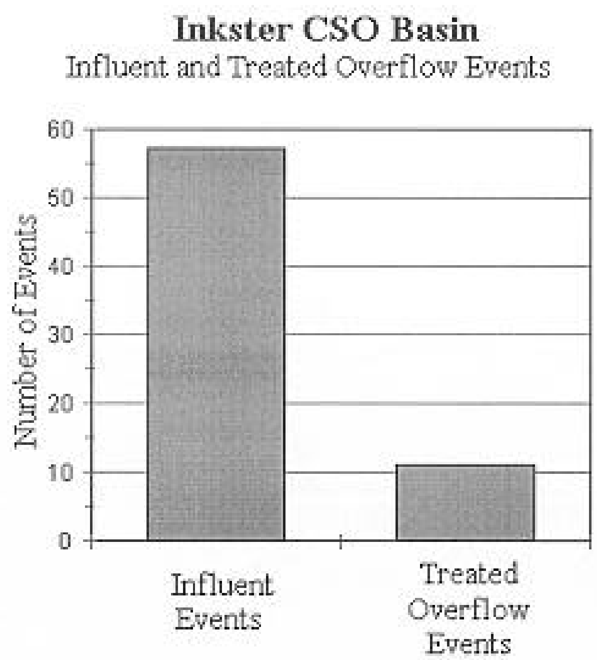
- Influent screens
- Influent pumping station
- First flush tank: 1.1 million gallons
- Main storage basin:
  Compartment 1 - 1.0 million gallons
  Compartment 2 - 1.0 million gallons
- Chlorination

Basin Diagram

Basin Performance

6/97 to 9/98

Influent Events	57
Treated Overflow Events	11



THE ROUGE RIVER PROJECT
A WORLD CLASS EFFORT

BRINGING OUR RIVER BACK TO LIFE

Rouge River National Wet Weather Demonstration Project

Wayne County, Michigan

CSO BASIN EVALUATION PLANS DATA COLLECTION AND TRANSFER GUIDE
RPO-NPS-TM33.00

August 1999

Rouge River National Wet Weather Demonstration Project

Wayne County, Michigan

CSO BASIN EVALUATION PLANS DATA COLLECTION AND TRANSFER GUIDE

Authors: Carol Hufnagel and Chris Catalfio

ACKNOWLEDGMENTS

The Rouge River National Wet Weather Demonstration Project is funded, in part, by the United States Environmental Protection Agency (EPA) Grant #X995743-01, #X995743-02, #X995743-03 and #C995743-01. The views expressed by individual authors are their own and do not necessarily reflect those of EPA. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.

Rouge River National Wet Weather Demonstration Project

MISSION STATEMENT

The mission of the Rouge River National Wet Weather Demonstration Project is to demonstrate effective solutions to water quality problems facing an urban watershed highly impacted by wet weather and develop potential solutions and implement projects which will lead to the restoration of water quality in the Rouge River. The project will address both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downstream water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state and local environmental laws which protect human health and the environment.

This will be accomplish through the development, implementation and financial integration of technical, social and institutional frameworks leading to cost-efficient and innovative watershed-based solutions to wet weather problems. This watershed-based national demonstration project will provide other municipalities across the nation facing similar problems with guidance and potentially effective solutions.

PREFACE

The Rouge River and its watershed are a primary source of pollution to the Great Lakes. The Clean Water Act of 1972 intended to make waterways "fishable and swimmable" by 1972. Although that goal has not been reached, great progress has been made in improving water quality in most waterways. The Rouge River Remedial Action Plan (RAP) provided a basis for which The Rouge River National Wet Weather Demonstration Project (Rouge Project) efforts were created: it identified the major sources of pollution and measured the relative contributions of each. The RAP is the continuing foundation for the Rouge Project and presents a framework for addressing the problems within the Rouge River by looking beyond treatment and focusing instead on prevention methods.

The Rouge Project was established under the initial Rouge Grant 1 from the United States Environment Protection Agency, Region 5, and enabled Wayne County to initiate a comprehensive watershed-wide pollution-control approach that addresses combined sewer overflow (CSO), stormwater management, and other nonpoint source controls through the application of innovative technologies, progressive financial and institutional arrangements, and creative public involvement and education programs.

Rouge Grant 2 provides the framework for the progression and implementation of Project goals as Wayne County continues its mission to develop potential solutions and implement projects which will lead to the restoration of water quality in the Rouge River. The Project will address both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downstream water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state, and local environmental laws which protect human health and environment.

This will be accomplished through the development, implementation, and financial integration of technical, social, and institutional frameworks leading to cost-efficient and innovative watershed-based solutions to wet weather problems. This watershed-based national demonstration project will provide other municipalities across the nation facing similar problems with guidance and potentially effective solutions.

Under Rouge Grant 2, the Rouge Project will build on lessons learned from Grant 1 efforts and focus on further integration of the goals of the overall Mission. To this end, Rouge Grant 2 concentrates on the following key Project areas:

- **Watershed Management** will continue under Rouge Grant 2 with the development and evaluation of wet weather and stormwater alternatives, the planning of long-term monitoring programs, and the ongoing efforts to enhance instream water quality, monitor rain and flow levels, interpret data analysis, and present recommendations.

- **Nonpoint Source Pollution Control** will provide for the stormwater management, permit applications, and development of financial and institutional alternatives for wet-weather watershed management in concert with enhanced efforts to establish institutional partnerships. Toward the goal of institutional partnering, several community projects will be undertaken with watershed communities. Additional efforts include the inventory of wetlands and measurement of pollutant loads from abandoned dumps and air deposition with possible remediation of some sites.

- **CSO Construction Coordination** will continue to monitor the construction of CSO demonstration projects established under Grant 1. Additional planning and assistance will allow project coordinators to make additional recommendations on the design criteria of future CSO abatement facilities.

- **Public Involvement and Information** will reach and interact with more stakeholders, institutions, and regulatory agencies, thus fostering a renewed understanding and continued commitment to reducing pollution, and continuing the transfer of watershed management approaches way beyond the project. It will be the central mechanism for transmittal of the Project's Decision Support System tools, processes, and information necessary for sustaining a watershed management support system directly to varied audiences both within and outside the Rouge watershed.

Additional information on the Rouge River Project is available from many sources, including the Wayne County Department of Environment (WCDOE) and the Rouge Program Office (RPO).

ABSTRACT

This technical memorandum summarizes procedures for the transfer of CSO basin data. The Rouge Program Office (RPO) has the role of comparing data collected at different CSO control facilities, providing comparative analysis, and providing a repository for basin data collected as part of the community basin evaluation monitoring programs. In order to ensure consistency of data, general guidelines for data transfer are provided in this document. All data received by the RPO will be loaded to the program database. This requires consistency of format in order to ensure that all needed information is provided and that data is correctly recorded in the database.

TABLE OF CONTENTS

LIST OF FIGURES

<u>Figure</u> <u>Page</u>

LIST OF TABLES

1.0 BASIN DATA COLLECTION/TRANSFER.

The RPO has identified certain data types to be of greatest value in evaluating basin performance. *Table 1.1* summarizes these data types, which are to be collected at each basin and submitted to the RPO within 60 days of the end of each month monitored. The submitted data will comprise direct measurements, laboratory analyses, and calculated values. Direct measurements will be made either by automatic equipment (for example, flow rates and basin levels) or by operators using field equipment (TRC, dissolved oxygen). Contract labs will provide laboratory analyses. The basin engineer will provide calculated values (for example, influent and effluent pollutant loads).

Table 1.1
Basin Data Collection

Data Type	Locations	Units	Significant Digits	Time Increment
1. Flow/cumulative volume measurement	All; includes influent, effluent, dewatering, decanting, collection system flows, all others monitored.	User specified: Flow: CFS, MGD or GPM. Cumulative volume: MGAL or FT3.	xxxx.xx	Maximum of 15 minutes during events. Daily totals for all dates. Event totals.
2. Basin volume stored	Each compartment and total.	MGAL	xx.xx	Maximum of 15 minutes during events. Instantaneous value at end of each day.
3. Basin levels	Each compartment.	FT	xx.x	Maximum of 15 minutes during events. Instantaneous value at end of each day.
4. Rainfall	At basin or nearest raingage.	IN	xx.xx	15 minutes during events. Peak 15 minute total. Daily totals for all dates. Event totals.
5. Pump operation	Influent, effluent, dewatering, decanting pumps (as applicable) - does not apply to chemical feed pumps, ground-water dewatering or basin flushing pumps.	log start and stop times as mm/dd/ yy hh:mm:ss for each pump at any location	not applicable	Maintain records. Submit paper copies. See Table A.8 in Appendix A for example.

6. Water Quality	Influent, effluent, basin compartments.	Typically MG/L, but depends on analytical method	depends on analytical method	Per monitoring plan.
7.Chlorine Dose Concentration	At each feed point (typically 1 per facility).	MG/L	xxx.x	During events.
8.CBOD, NH3, TSS and Total Phosphorus Load	Influent and effluent.	LB	xxxx.	Daily totals for all dates. Event totals.

Data collected at each basin will be transferred to the RPO monthly within 60 days of the end of each month monitored through four types of reports:

- Time Series Data Reports
- Daily Summary Reports
- Analytical Summary Reports
- Event Summary Reports and Plots

For reporting purposes, a basin event begins when inflow to a basin occurs in response to a rain event. A basin event ends when the basin is completely dewatered, whether or not overflows ever occurred. Two distinctly separate rain events may still be considered part of one basin event if the basin is not completely dewatered between the rain events.

Time Series Data Reports will be submitted for all individual basin events each month (not limited to those that result in overflow to the river) and will typically contain instantaneous flow rate, basin compartment level data, stored volumes, cumulative volumes, 15 minute rainfall totals and chlorine dose concentrations. Daily Summary Reports will be submitted each month and will contain daily totals of basin inflow, overflow, dewatering, and decanting volumes, compartment level data, stored volumes (midnight), total volumes (midnight), total influent and effluent pollutant loads and daily rainfall totals. Analytical Summary Reports will also be submitted each month and will contain laboratory analytical results for all samples collected during that month. Event Summary Reports will be submitted each month and will include event total rainfall, event peak 15-minute rainfall volume, event influent total volume and duration, event effluent total volume and duration and event influent and effluent loads. They will also include paper copies of event summary plots.

Each location from which data will be collected will have a unique Field ID. *Figure 1-1* shows a "typical" basin in schematic view, and identifies nine data collection locations. For example, the "Basin Inflow" location (Field ID: BB01) contains a flow meter and a sample point. Data to be collected from this location will include:

Time Series Data Reports
- instantaneous flow rate measurements
- cumulative volumes

Daily Summary Reports
- total daily inflow volumes
- total daily influent pollutant loads

Analytical Summary Reports
- lab results for discrete (grab or automatic) and composite pollutant samples

Event Summary Reports
- event total volume
- event total duration
- event total pollutant loads
- event plots

As another example, the “Basin Compartment #3” location (Field ID: BB30) has a level sensor and a sample point. Data to be collected from this location will include:

Time Series Data Reports
- instantaneous basin level measurements, during both fill and decant as applicable
- instantaneous stored volumes

Daily Summary Reports
- total volume stored in basin at the end of each day (Midnight)

Analytical Summary Reports
- lab results for discrete (grab or automatic) pollutant samples (possibly at varying depths)

Each monitoring location at each basin will have a 4-character name according to the following general convention: BBSS where BB refers to the basin and SS refers to individual locations for each basin. All data for the facility will need to be identified with the Field ID corresponding to the location at which it was collected. Basin IDs are as follows:

Basin	Character ID
DWSD Hubbell-Southfield	HS
DWSD Seven Mile	SM
DWSD Puritan-Fenkell	PF
Dearborn Heights	DH
Inkster	IN
Redford	RF
Acacia	AC

Bloomfield Village	BV
Birmingham	BR
River Rouge	RR

The SS numbers will refer to individual locations at each basin. While each basin may have a number of locations specific to that basin (for example, overflow weirs between various compartments), the following location IDs are suggested at a minimum, in order to distinguish between different flows and samples:

Location	Numeric ID
Basin Inflow	01
Basin Outflow	02
Basin Dewater	03
Basin Decant	04
Total Volumes	00

Data should be submitted in Excel spreadsheet format or comma-delimited ASCII files. Four separate files should be submitted each month, one for each type of report. If Excel spreadsheets are used, all data within each file must be contained on a single tab. All files submitted should be named using the following naming convention: BBMMYYRR.xls, where BB: basin ID, MM: month, YY: last 2 digits of year, RR: type of report (TS, DS, AS, ES). Subsequent sections of this guide summarize the types of data to be included in each report and provide detailed descriptions of the required formats. Example reports are provided that refer to the Field IDs shown in *Figure 1-1*.

1.1 TIME SERIES DATA REPORTS. *Table 1.2* presents an example of the general format to be used for time series reports. The example includes flow and level data from the "Basin Inflow" and "First Flush Compartment" locations, as shown in *Figure 1-1*. For Excel spreadsheets, each file should have one tab containing rain, level, cumulative volumes, stored volumes, chlorine dose concentrations and flow data. Note that each value is reported on an individual line. The database loading program will read each line individually for storage. A title on the page is not necessary. The spreadsheet should be set-up with the following column headers: FIELD_ID, DATE, TIME, PARAM_ID, UNITS, VALUE, FLAG and FFLAG. Note case, underscore and spacing. Since all parameters are to be included in a single file they should be sorted by parameter (that is, rain, flow, etc.). The locations where flow is monitored will likely include the influent, the effluent, dewatered flow and the decanted flow. Other flow meters may be present. Data should be collected from all locations with flow meters. Despite advances in flow metering technology, the most accurate way to evaluate the fill rates and the total volume stored is by keeping track of the water level in the basin. To assist with level-based volume calculations, basin levels should be recorded to the tenth of a foot and included in each time series report. Level measurements, in feet, are referenced to some arbitrary datum. Depth measurements, in feet, are bottom to surface measurements.

FIGURE 1-1

Schematic of "Typical" Basin

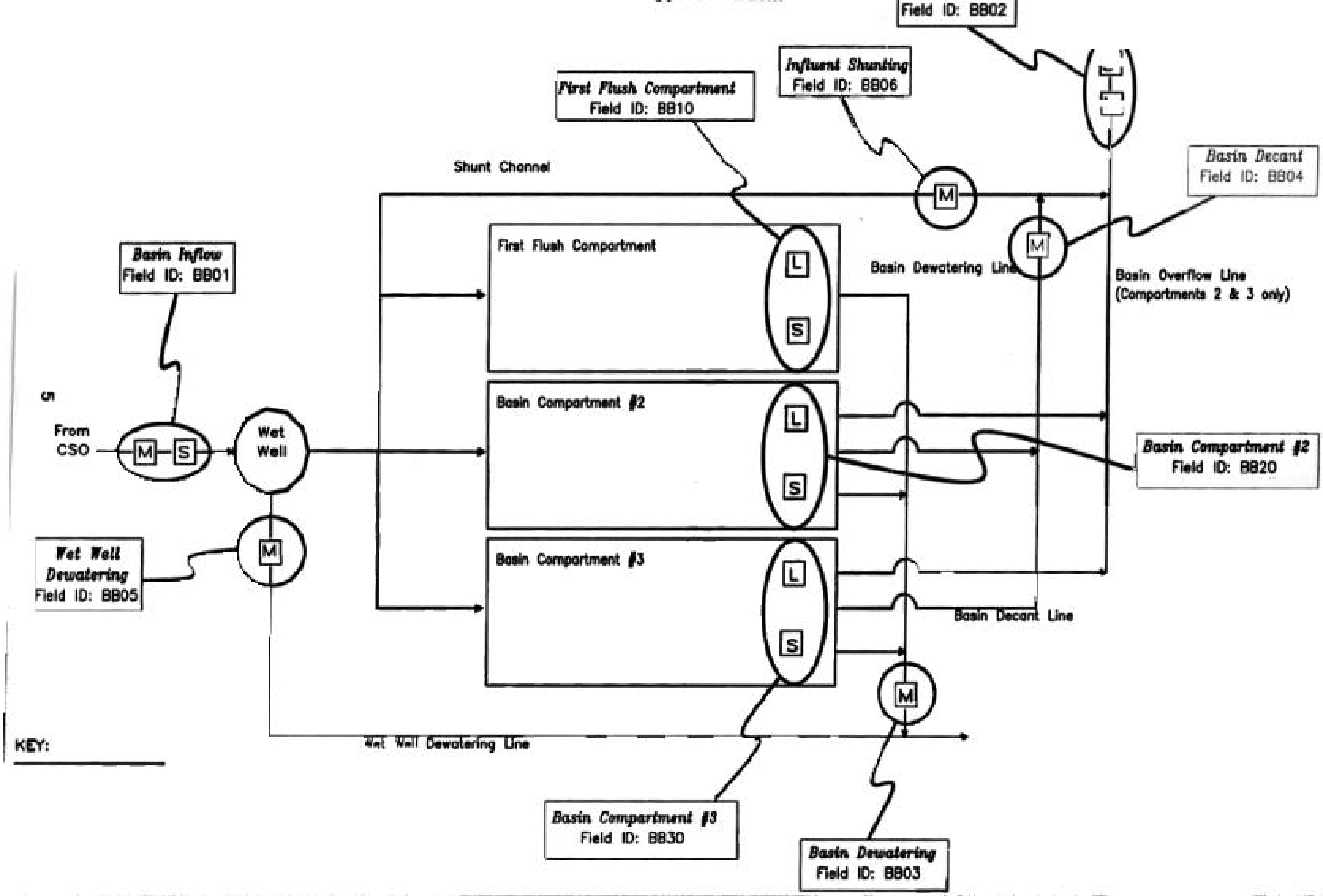


Table 1.2
Example Time Series Report

FIELD_ID	DATE	TIME	PARAM_ID	UNITS	VALUE	FLAG	FFLAG
BB01	04/01/97	14:45	FLOW	CFS	0	EST	NONE
BB01	04/01/97	15:00	FLOW	CFS	12.2	EST	NONE
BB01	04/01/97	15:15	FLOW	CFS	48.2	EST	NONE
BB01	04/01/97	15:30	FLOW	CFS	63.4	EST	NONE
BB01	04/01/97	15:45	FLOW	CFS	56.2	EST	NONE
BB01	04/01/97	16:00	FLOW	CFS	10.0	EST	NONE
BB01	04/01/97	16:15	FLOW	CFS	0.0	EST	NONE
BB10	04/01/97	14:4	LEVEL	FT	0.0		NONE
BB10	04/01/97	15:00	LEVEL	FT	0.6		NONE
BB10	04/01/97	15:15	LEVEL	FT	3.8		NONE
BB10	04/01/97	15:30	LEVEL	FT	9.6		NONE
BB10	04/01/97	15:45	LEVEL	FT	10.0		NONE
BB10	04/01/97	16:00	LEVEL	FT	10.0		NONE
BB10	04/01/97	16:15	LEVEL	F	10.0		NONE

Standard formats for each item in time series report

1. FIELD_ID: Corresponding facility and location information.

2. DATE: Date when data was collected, month/day/year.

3. TIME: Local time when data was collected (EDT or EST, as appropriate). Times must be reported in military (24-hour) format, hour:minutes.

4. PARAM_ID: Standard data types will include flow, level, stored volume, cumulative volume, chlorine dose concentration and rain. See Table A.1 in Appendix A for time series parameter identification and description.

5. UNITS: User-specified. Types expected include: MGD, GPM, IN, FT, CFS, MGAL, CF, MG/L, etc. Must be appropriate unit for data type. See Table A.1 in Appendix A for units of measurement and description.

6. VALUE:Result should correspond to data described. Results which are known to be erroneous should not be reported. If for whatever reason there is no result, but a reasonable estimate can be made, the estimated value should be entered here and flagged as estimated data in the FLAG field and NONE entered in the FFLAG field. If a reasonable estimate cannot be made, the entire line of data should not be reported (i.e. the result field should never be blank).

7. FLAG: To be used when result requires additional information. Enter appropriate Raw Flag from Table A.5 in Appendix A.

8. FFLAG: This column must have an entry. To be used to accept, flag as questionable or reject data. Enter appropriate Final Flag from Table A.5 in Appendix A.

1.2 DAILY SUMMARY REPORTS. In addition to the time series reporting, daily data will be reported each month in a summary format, similar to discharge monitoring reports that are submitted to the Michigan Department of Environmental Quality (MDEQ). *Table 1.3* provides an example of the desired daily summary report sheet format. In the example, the daily total volume of flow at three locations (inflow, overflow, and dewatering), the daily rain and the daily CBOD load (inflow) is provided. For Excel spreadsheets, each file should have one tab containing daily rain, daily level, daily cumulative volumes, daily stored volumes, daily CBOD load, etc. A title on the page is not necessary. The spreadsheet should be set-up with the following column headers: FIELD_ID, DATE, PARAM_ID, UNITS, VALUE, FLAG and FFLAG. Note case, underscore and spacing. Since all parameters are to be included in a single file they should be sorted by parameter (that is, daily volume, daily rain, daily CBOD load, etc.).

Table 1.3
Example Daily Summary Report

FIELD _ ID	DATE	PARAM _ ID	UNITS	VALUE	FLAG	FFLAG
BB01	04/01/97	DAILY_VOLUME	MGAL	0.53		NONE
BB01	04/02/97	DAILY_VOLUME	MGAL	9.44		NONE
BB01	04/03/97	DAILY_VOLUME	MGAL	6.32		NONE
BB02	04/01/97	DAILY_VOLUME	MGAL	0.0		NONE
BB02	04/02/97	DAILY_VOLUME	MGAL	4.92		NONE
BB02	04/03/97	DAILY_VOLUME	MGAL	1.02		NONE
BB03	04/01/97	DAILY_VOLUME	MGAL	0.53		NONE
BB03	04/02/97	DAILY_VOLUME	MGAL	9.44		NONE
BB03	04/03/97	DAILY_VOLUME	MGAL	6.32		NONE
BB83	04/01/97	DAILY_RAIN	IN	0.31		NONE
BB83	04/02/97	DAILY_RAIN	IN	1.32		NONE
BB83	04/03/97	DAILY_RAIN	IN	1.40		NONE
BB01	04/01/97	DAILY_CBOD_LOAD	LB	225		NONE
BB01	04/02/97	DAILY_CBOD_LOAD	LB	2200		NONE
BB01	04/03/97	DAILY_CBOD_LOAD	LB	860		NONE

Standard formats for each item in daily summary report

1. **FIELD_ID**: Corresponding facility and location information.

2. **DATE**: Date when data was collected, month/day/year. Note: all total flow volumes, rainfall volumes, etc. are to be summed from midnight to midnight.

3. **PARAM_ID**: Standard data types will include daily cumulative volumes, daily levels, daily stored volumes, daily rain and daily loads. See Table A.2 in Appendix A for daily summary parameter identification and description.

4. **UNITS**: User-specified. Types expected include: MGAL, IN, FT, LB. Must be appropriate unit for data type. See Table A.2 in Appendix A for units of measurement and description.

5. **VALUE**: Result should correspond to data described. Results which are known to be erroneous should not be reported. If for whatever reason there is no result, but a reasonable estimate can be made, the estimated value should be entered here and flagged as estimated data in the FLAG field and NONE entered in the FFLAG field. If a reasonable estimate cannot be made, the entire line of data should not be reported (i.e. the result field should never be blank).

6. **FLAG**: To be used when result requires additional information. Enter appropriate Raw Flag from Table A.5 in Appendix A.

7. **FFLAG**: This column must have an entry. To be used to accept, flag as questionable or reject data. Enter appropriate Final Flag from Table A.5 in Appendix A.

1.3 ANALYTICAL SUMMARY REPORTS. Analytical results include both laboratory and on-site measurements (such as dissolved oxygen, TRC, etc.). *Table 1.4* summarizes the general information to be reported regarding water quality measurements and analysis:

Table 1.4
Summary of Analytical Reporting Requirements

Type of Information	Remarks
Date and time of sample collection	Start and stop time associated with the sample. For discrete samples enter the time of sample collection. For composite samples start time will be the time the first sample was collected and stop time will be the time the last sample was collected.
Location of sample collection	Site identifier for each sample collection point

Sample identification number	Standard RPO sample identification format
Sample results	Laboratory/field measurement results
Sample qualifiers (flags)	Includes BDL (below detection limit) and other flags
Analytical technique/detection limits	Identifies laboratory method used and laboratory detection limits

Table 1.5 presents a sample Analytical Results spreadsheet format. A title on the page is not necessary. The standard formats for the items are discussed below. Note case, underscore and spacing.

Table 1.5
Example Analytical Summary Report

FIELD_ID	COLL_DATE1	COLL_TIME1	COLL_DATE2	COLL_TIME2	SAM_TYPE	SAMPLE_ID	PARAM_ID	V	RESULT	UNITS	FLAG1	FLAG2	FFLAG	MDL	MDL_UNITS	METHOD	LAB	SAM_LEVEL	LEVEL_UNITS
BB01	04/01/97	14:45			AUTO	BB01704011445A01	CBOD5		2.3	MG/L			NONE	2	MG\L	405.1	HVL		
BB01	04/01/97	14:45	04/01/97	16:45	EC	BB01704011445EC1	CBOD5		2.6	MG/L			NONE	2	MG\L	405.1	HVL		
BB01	04/01/97	14:45			AUTO	BB01704011445A01	TSS		14	MG/L			NONE	1	MG\L	160.2	HVL		
BBO2	04/01/97	15:45			AUTO	BB02704011545A01	CBOD5	<	2.0	MG/L	BDL	HT	NONE	2	MG\L	405.1	HVL		
BB21	04/01/97	18:45			DECANT	BB21704011845D01	CBOD5		5.0	MG/L			NONE	2	MG\L	405.1	HVL	5.0	FT

<u>Standard formats for each item in analytical spreadsheet</u>

1. FIELD_ID: Corresponding facility and location information.
2. COLL_DATE1: Start date when data was collected, month/day/year.
3. COLL_TIME1: Local start time when data was collected (EDT or EST, as appropriate). Times must be reported in military (24-hour) format, hour:minutes.
4. COLL_DATE2: For composite samples only; leave blank for discrete samples. Stop date when data was collected, month/day/year.
5. COLL_TIME2: For composite samples only; leave blank for discrete samples. Local stop time when data was collected (EDT or EST, as appropriate). Times must be reported in military (24-hour) format, hour:minutes.
6. SAM_TYPE: Discrete samples either GRAB or AUTO. Composite samples EC. For quality assurance samples, special composites and decant samples refer to Table A.4 in Appendix A.
7. SAMPLE_ID: 16 characters: BBSSYMMDDHHmmT##. BB: basin ID, SS: monitoring location, Y: last digit of year, MM: month, DD: day, HH: hour, mm: minute (date/ time is start sample time), T: type (G-grab, A-automatic, EC-composite,), ##: serial number for consecutive samples from a given location. For quality assurance samples, special composites and decant samples refer to Table A.4 in Appendix A for the appropriate T## designation.
8. PARAM_ID: Standard RPO abbreviation for parameter being analyzed. See Table A.3 in Appendix A for a list of standard abbreviations.
9. V: If a "<" or ">"is required, show in this column. Include value indicator flag description in FLAG1 column. See Table A.5 in Appendix A.
10. RESULT: Numerical result. Results which are known to be erroneous should still be reported and assigned a FFLAG of "R", for rejected. If no analyses were performed or no result was obtained, retain for your records, but do not include in report.
11. UNITS: Units of measurement for a particular parameter. See Table A.3 in Appendix A for a list of units of measurement.
12. FLAG1: Use for any laboratory or field flags (such as HT - holding time, or BDL - below detection limit). Use FLAG1 first and then FLAG2 if a second flag applies. Select appropriate Raw Data flag from Table A.5 in Appendix A.
13 FLAG2: If a second laboratory or field flag is required complete this column. Select appropriate Raw Data flag from Table A.5 in Appendix A.
14. FFLAG: This column must have an entry. To be used to accept, flag as questionable or reject data. Select appropriate Final Flag from Table A.5 in Appendix A.
15. MDL: Detection limit of laboratory or field methodology.
16. MDL_UNITS: Units of method detection limit. See Table A.3 in Appendix A for a list of units of measurement and descriptions.
17. METHOD: Reference to EPA or Standard Method (SM) numbers. Identify one method per parameter. Do not include both the EPA and SM numbers. See Table A.3 in Appendix A for a list of available methods and descriptions.
18. LAB: Identification of laboratory or organization performing analyses. For analyses performed at basin use basin identification as laboratory. See Table A.6 in Appendix A for a list of available organizations and laboratories and descriptions. If using an organization or laboratory not listed in Table A.6, select an appropriate abbreviation and use it consistently.
19. SAM_LEVEL: Referenced to the same datum as the reported compartment water level data. Basins will, on occasion, be required to sample for water quality at various levels in the basin. This field will be used to record the water level at which each sample was collected. This column requires completion when decant samples are collected.
20. LEVEL_UNITS: Units of level measurement (FT) for levels reported in SAM_LEVEL field.

1.4 EVENT SUMMARY REPORTS AND PLOTS. At times it is necessary to generate event reports based on the time series data. Therefore, an event summary report and plot is needed for every event. *Table 1.6* provides an example of the desired event summary report sheet format. An example of the event summary plot format is included in Appendix B.

1.4.1 Event Summary Report. For the event summary report submit one file with one tab for event total rain, event peak 15-minute rain volume, event cumulative volumes, event loads and event duration. A title on the page is not necessary. The spreadsheet should be set-up with the following column headers: FIELD_ID, DATE1, TIME1, DATE2, TIME2, PARAM_ID, UNITS, VALUE, FLAG, FFLAG AND EVENT_NUM. Note case, underscore and spacing. Since all parameters are to be included in a single file they should be sorted by parameter (that is, event volume, event rain, event duration, etc.).

Table 1.6
Example Event Summary Report

FIELD_ID	DATE1	TIME1	DATE2	TIME2	PARAM_ID	UNITS	VALUE	FLAG	FFLAG	EVENT _NUM
BB82	07/07/98	14:55	07/08/98	18:00	EVENT_RAIN	IN	0.43	CAL	NONE	
BB82	07/07/98	14:55	07/08/98	18:00	EVENT_15MINPEAK	IN	1.12	CAL	NONE	
BB01	07/07/98	14:55	07/08/98	18:00	EVENT_VOLUME	MGAL	7.20	CAL	NONE	
BB02	07/07/98	14:55	07/08/98	18:00	EVENT_VOLUME	MGAL	4.00	CAL	NONE	
BB01	07/07/98	14:55	07/08/98	18:00	EVENT_DURATION	HH:MM	20:45	CAL	NONE	
BB02	07/07/98	14:55	07/08/98	18:00	EVENT_DURATION	HH:MM	13:00	CAL	NONE	
BB01	07/07/98	14:55	07/08/98	18:00	EVENT_TSS_LOAD	LB	1205	CAL	NONE	
BB02	07/07/98	14:55	07/08/98	18:00	EVENT_TSS_LOAD	LB	216	CAL	NONE	

The date/time fields in the Event Summary Report are intended to reflect a date/time range which fully encompasses the date/time of all data values included in the Time Series Data Report for the same event.

In addition to the electronic report submitted, paper copies of the Event Summary Plots are needed. These should be submitted with the monthly reports and should include plots of the event; rainfall, flow hydrograph, CBOD5 concentration, TSS concentration, total phosphorus concentration, ammonia concentration, fecal coliform concentration, TRC concentration and NaOCl dose concentration, dissolved oxygen and temperature and pH.

Standard formats for each item in event summary spreadsheet

1. **FIELD_ID**: Corresponding facility and location information.

2. **DATE1**: Start date of the values reported in the Time Series Data Report, month/day/year.

3. **TIME1**: Local time associated with the earliest value reported in the Time Series Data Report (EDT or EST, as appropriate). Times must be reported in military (24-hour) format, hour:minutes.

4. **DATE2**: End date of values reported in the Time Series Data Report, month/day/year.

5. **TIME2**: Local time associated with the latest value reported in the Time Series Data Report (EDT or EST, as appropriate). Times must be reported in military (24-hour) format, hour:minutes.

6. **PARAM_ID**: Standard data types will include event rain, event 15-minute peak volume, event volume, event pollutant loads and event duration. See Table A.7 in Appendix A for event parameter identification and description.

7. **UNITS**: User-specified. Types expected include: IN, MGAL, HH:MM and LB. Must be appropriate unit for data type. See Table A.7 in Appendix A for units of measurement and description.

8. **VALUE**: Result should correspond to data described. Results which are known to be erroneous should not be reported. If for whatever reason there is no measured or calculated result, a reasonable estimate should be entered here, flagged as estimated data in the FLAG field and NONE in the FFLAG field.

9. **FLAG**: To be used when result requires additional information. Enter appropriate Raw Flag from Table A.5 in Appendix A.

10. **FFLAG**: This column must have an entry. To be used to accept, flag as questionable or reject data. Enter appropriate Final Flag from Table A.5 in Appendix A.

11. **EVENT_NUM**: Leave blank, the RPO will assign this number. This number will be assigned to give each event unique identification.

1.4.2 Event Summary Table, Plots and Tabular Summary. Event Summary Tables, Plots and Tabular Summaries are to be prepared for each event where basin inflow occurred in response to a rain event, regardless of how complete the sampling results are for the event. The specific table, plot and tabular summary format is shown in an example in Appendix B. Each page of the table, plots and tabular summary for each event should have the same header that clearly indicates the name of the facility and the date of the event. A standard template per the example should be used consistently, even if certain graphs on a page contain no data. In general the standard template should include the following, but the standard template may need to be modified or expanded to accommodate the results of any special sampling.

Page B - 1: Summary Table
Page B - 2: Plots of Rainfall; Flow; CBOD5 (or BOD5) along with UBOD; and TSS
Page B - 3: Plots of NH3, Total Phosphorous; Fecal Coliform; and TRC along with Estimated Chlorine Dose Concentration
Page B - 4: Plots of DO; Temperature; pH; Oil & Grease; Chlorides and any other parameters for which discrete sampling was performed.
Page B - 5: Tabular Summary

Standard formats for each item in summary table (page B - 1)

1. **Above Table**: Indicate the basin size (million gallons) and the combined sewer drainage area tributary to the basin (acres). Indicate the event total rainfall (inches) and the Field ID of the gage the totals are based on. These values should be identical to what is provided in the Event Summary Report.

2. **Flow**: Indicate the influent and effluent volume (million gallons, and inches over the drainage area in parenthesis) and duration (hours:minutes in military format). These values should be identical to what is provided in the Event Summary Table.

3. **Discrete Water Quality**: Indicate the parameters for which discrete influent and/or effluent samples/measurements were taken. Indicate the number of readings for each parameter.

4. **Composite Water Quality**: Indicate all parameters for which composite samples were analyzed, along with the result and units for each sample.

5. **Visual Observations**: Describe any visual observations of the basin effluent.

6. **Special Monitoring**: Describe any special monitoring performed such as sampling at the decant, swirl, intermediate weir, or at various depths within the basin. Identify the parameters analyzed and the number of samples per location. The summary table and discrete water quality plots should also be modified as appropriate to clearly communicate these results in a similar fashion as the influent and effluent data. For example, decant flow and sampling data could be added as a third symbol to all the appropriate plots, and a second page could be added to the summary table with the two columns labeled “Influent” and Effluent” replaced by a single column labeled “Decant.”

7. **Operational Notes**: Specify the basin operating mode as first-flush capture or flow-through. Also describe any operational, equipment or monitoring problems which occurred during the event that could aid in interpreting the monitoring results.

<u>Standard formats for each item in plots (pages B-2 through B-4)</u>

1. **General**: Clearly label the title and legend of each plot. Label each axis with the parameter followed by the units in parenthesis. Abbreviations for units should be consistent with those used in the various reports described earlier in this document. The horizontal axis of each plot should reflect military time. Select minimum and maximum values of vertical axis appropriately so data make use of much of the vertical range on the plots.

2. **Rainfall**: Bar chart should reflect 15 minute rainfall totals.

3. **CSO Flow Hydrograph**: Plot measured, computed or estimated influent and effluent flow hydrographs using two distinctly different line weights/types.

4. **All Other Parameters**: Plot all water quality sample or field measurement results using distinctly different symbols for each sampling location. For values which are above or below a detection limit, plot the values as equal to the detection limit. Do not plot lines between data points.

<u>Standard formats for tabular summary (pages B - 5 through B - 7)</u>

1. **General**: The tabular summary should include all of the analytical data from the event. The tabular data should be sorted by parameter, location, date and time.

2. **Parameter**: Identification should be consistent with identification in the analytical summary, refer to Table A.3 in Appendix A.

3. **Sample Location**: Location description; influent, effluent, decant, swirl, intermediate weir, etc.

4. **Sample Type**: Enter auto, grab or composite.

5. **Date**: Date of values reported, month/day/year.

6. **Time**: Time of values reported in military format, hour:minutes.

7. **Value**: Value to be reported.

8. **Units**: Units of value reported, refer to Table A.3 in Appendix A.

9. **Detection Limit**: Detection limit of laboratory or field methodology.

10. **Method Detection Limit Units**: Units of method detection limit, refer to Table A.3 in Appendix A.

11. **Method**: EPA or Standard Method number, refer to Table A.3 in Appendix A.

12. **Final Flag**: Final Flag should correspond to the final flag used in the analytical summary report, refer to Table A.5 in Appendix A.

2.0 BASIN DATA ANALYSIS.

2.0 BASIN DATA ANALYSIS. Certain basin operating parameters to be reported in the Daily Summary Reports, Analytical Summary Reports and Event Summary Reports will have to be calculated by the basin engineer. Examples include influent and effluent pollutant loads, the volume of water remaining in basin compartments at the end of each day, composite sample flow volumes and the duration of events. While the calculations will be straightforward, it is important that they be performed in a consistent manner from basin to basin, so that results can be compared directly. The following sections describe how the calculations should be made.

2.1 BASIN STORED VOLUME. The volume of water in a basin compartment is simply the water level, as provided by the level sensor, multiplied by the area of the basin floor. The actual area of each basin compartment should be verified from as-built construction drawings and, if possible, included in the header of the Daily Summary Reports. The basin level reading used for Basin Stored Volume calculations should be taken at midnight, corresponding to the previous day. That is, the basin level at one minute after 02/14/97 23:59 will be used to calculate the volume stored for 02/14/97. The person responsible for the calculations should retain all spreadsheets and/or hand calculations for the duration of the basin evaluation study.

2.2 DAILY POLLUTANT LOADS. The collection of flow-paced composite samples of basin inflow and overflow simplifies the calculation of total pollutant loading. As each fractional volume of the composite sample represents an equal volume of flow, the resulting composite amounts to a flow-weighted average concentration, and the total load can be calculated as follows:

$$Wi = Q*Ci*8.34$$

where

Wi	=	Total load of ith pollutant, LB
Q	=	Total volume of flow, MGAL
Ci	=	Concentration of ith pollutant in flow-paced composite sample, MG/L

Total pollutant loads can also be calculated from discrete sample results and time series flow data. There are several approaches that can be taken; the following approach makes use of all the flow data and produces reasonably accurate results.

The first step involves calculation of cumulative total flow as shown in *Table 2.1*. The integration formula in Column C should be copied down to the end of the time series flow data. The resulting values represent the cumulative flow at each time in Column A.

Table 2.1
Spreadsheet Calculation of Cumulative Volume

	A	**B**	**C**
1	Time HH:MM	Flow CFS	Cumulative Volume MGAL
2	18:35	0	
3	18:40	0.51	=((B2+B3)/2*(A3-A2)*60*7.48/1000000)+C2
4	18:45	2.83	
5	18:50	4.41	
6	18:55	3.13	
7	19:00	3.29	
8	19:05	3.16	
9	19:10	3.19	
10	19:15	2.85	
11	19:20	1.21	
12	19:25	1.01	
●	●	●	●
●	●	●	●
25	20:30	0	

The second step involves matching cumulative flow volumes with the discrete samples taken at corresponding times. In the case where sample collection times do not exactly match flow measurement times, the required cumulative volume is calculated from a linear interpolation formula as shown in *Table 2.2* below.

Table 2.2
Linear Interpolation of Cumulative Volume

	A	B	C
1	Time HH:MM	Flow CFS	Cumulative Volume MGAL
2	18:35	0	
3	18:40	0.51	0.000572
4	18:45	2.83	0.00432
5	18:50	4.41	0.012443
6	18:55	3.13	0.020903
7	19:00	3.29	0.028106
8	19:02	=(B9-B7)/(A9-A7)*(A8-A7)	=((B7+B8)/2*(A8-A7)*60*7.48/1000000)+C7
9	19:05	3.16	0.035343
10	19:10	3.19	0.042468
●	●	●	●
●	●	●	●
25	20:25	0.05	0.105255
26	20:30	0	0.105311

The final step involves calculating the cumulative loading from the discrete sample results and corresponding cumulative flow volumes, as shown in *Table 2.3* below. Note that the formula in D2 is different from that in D3. The formula in D3 should be copied down for each pair of concentration and cumulative flow data; the value in the last cell represents the total load for the event (which in this example comes out to 93.2 lb.). If the cumulative volume continues beyond the last sample collected and at least 80 percent of the volume was sampled then use the last concentration measurement in determining cumulative load. If 80 percent of the volume was not sampled then flag the results describing that the sampling was incomplete.

Table 2.3
Spreadsheet Calculation of Cumulative Pollutant Load

	A	B	C	D
1	Time HH:MM	Cumulative Flow (MGAL)	Concentration (MG/L)	Cumulative Load (LB)
2	18:45	0.00432	152	=C2*B2*8.34
3	19:02	0.031001	148	=(C2+C3)/2*(B3-B2)*8.34+D2
4	19:15	0.049245	120	
5	19:30	0.074849	65	
6	20:00	0.101878	50	
7	20:30	0.105311	37	

While this method is time-consuming, it does provide a graphical representation of the change in pollutant loading rate over time. For simplicity's sake, however, total daily pollutant loads should be calculated from flow-paced composite samples whenever possible.

APPENDIX A

Table A.1
Time Series Data Report
Data Parameters and Units

PARAM_ID	**PARAM_ID DESCRIPTION**	**UNITS**	**UNITS DESCRIPTION**
15_MIN_RAIN	15 minute rainfall totals	IN	Inches
LEVEL	Instantaneous water level referred to arbitrary datum in each compartment	FT	Feet
FLOW	Instantaneous flow measurement	MGD,CFS,GPM	Million Gallons per Day, Cubic Feet per Second, Gallons per Minute
STORED_VOLUME	Volume of water stored at a given time	MGAL,FT3	Millions Gallons, Cubic Feet
CUM_VOLUME	Totaalvolume of water which has flowed past a given location since the start of an event	MGAL,FT3	Million Gallons, Cubic Feet
CL_DOSE_CONC	Chlorine concentration just past the point of injection assuming instantaneous mixing.	MG/L	Milligrams per Liter

Table A.2
Daily Summary Report
Data Parameters and Units

PARAM_ID	PARAM_ID DESCRIPTION	UNITS	UNITS DESCRIPTION
DAILY_RAIN	Daily rainfall total	IN	Inches
DAILY_LEVEL	Instantaneous water level referred to arbitrary datum in each compartment at end of reporting day (midnighta0	FT	Feet
DAILY_CUM_VOLUME	Total volume of water which had flowed past a given location within the given calendar day.	MGAL	Million Gallons
DAILY_STORED_VOL	Volume stored in each basin compartment and total stored volume at end of reporting day (midnight). To be calculated from basin level.	MGAL	Millon Gallons
DAILY_CBOD_LOAD DAILY_TSS_LOAD DAILY_NH3_LOAD DAILY_TOTAL_PHOS_LOAD	Total pollutant load which has flowed past a given location within the given calendar day. For influent and effluent locations only. To be calculated from flow based composite or discrete sample concentrations and cumulative flows.	LB	Pounds

Table A.3
Analytical Summary Report
Data Parameters, Units and Method Identification

				EPA METHOD		OTHER METHODS	
PARAM_ID	**PARAM_ID DESCRIPTION**	**UNITS**	**UNITS DESCRIPTION**	**METHOD**	**METHOD DESCRIPTION**	**METHOD**	**METHOD DESCRIPTION**
ALK	Alkalinity (as CaCO3)	MG/L	Milligrams per Liter	310.1	EPA Standard Method for Alkalinity	2320	Standard Method for Alkalinity
BOD5	5-Day Biochemical Oxygen Demand	MG/L	Milligrams per Liter	405.1	EPA Standard Method for BOD	SM5210B	Standard Method for BOD5
CBOD5	5-Day Carbonaceous BOD	MG/L	Milligrams per Liter	405.1	EPA Standard Method for CBOD		
Cl	Chloride	MG/L	Milligrams per Liter	325.3	EPA Standard Method for Chloride		
COD	Chemical Oxygen Demand	MG/L	Milligrams per Liter	410.4	EPA Standard Method for Chemical Oxygen Demand		
COND	Conductivity	mS/cm	Microsiemans per centimeter	120.1	EPA Standard Method for Conductivity		
DO	Dissolved Oxygen	MG/L	Milligrams per Liter			WINKLER YSISOLO	Winkler Dissolved Oxygen YSI or Solomat Dissolved Oxygen Sensor
F_COLI	Fecal Coliform	#/100 ML	Number per 100 milliliters			9222D or SM9222D	Standard Method for Fecal Coliform
FRC	Free Residual Chlorine	MG/L	Milligrams per Liter			HACHLAM	HACH or LaMotte Test Kits
HARD	Hardness (as CaCO3)	MG/L	Milligrams per Liter	130.2	EPA Standard Method for Hardness		
NH3	Ammonia	MG/L	Milligrams per Liter	350.1 or 350.2 or 350.3	EPA Standard Method for NH3		
OIL_GRS	Oil and Grease	MG/L	Milligrams per Liter	413.1	EPA Standard Method for Oil and Grease		
PHOS_T	Total Phosphorus	MG/L	Milligrams per Liter	365.2 or 365.3 or 365.4	EPA Standard Method for Total Phosphorus		
pH	pH	SU	Standard Units	150.1	EPA Standard Method for pH		
SBOD	Soluble Fraction BOD5	MG/L	Milligrams per Liter	405.1	EPA Standard Method for SBOD		
SCBOD	Soluble Fraction CBOD5	MG/L	Milligrams per Liter	405.1	EPA Standard Method for SCBOD		
WTRTEMP	Water Temperature	C	Degrees Celsius			SM2550B	Standard Method for Water Temperature
TOC	Total Organic Carbon	MG/L	Milligrams per Liter	415.1	EPA Standard Method for Total Organic Carbon		
TRC	Total Residual Chorine	MG/L	Milligrams per Liter			HACHLAM	HACH or LaMotte Test Kits
TSS	Total Suspended Solids	MG/L	Milligrams per Liter	160.2	EPA Standard Method for Total Suspended Solids		
UBOD	Ultimate BOD	MG/L	Milligrams per Liter			SM5210C	Standard Method for UBOD
UCBOD	Ultimate CBOD	MG/L	Milligrams per Liter			SM5210C	Standard Method for UCBOD
AS_D	Dissolved Arsenic	MG/L	Milligrams per Liter	206.2	EPA Standard Method for Dissolved Arsenic		
CD_D	Dissolved Cadmium	MG/L	Milligrams per Liter	213.2	EPA Standard Method for Dissolved Cadmium		
CR_D	Dissolved Chromium	MG/L	Milligrams per Liter	218.2	EPA Standard Method for Dissolved Chromium		
CU_D	Dissolved Copper	MG/L	Milligrams per Liter	220.2	EPA Standard Method for Dissolved Copper		
HG_D	Dissolved Mercury	MG/L	Milligrams per Liter	245.1	EPA Standard Method for Dissolved Mercury		

PB_D	Dissolved Lead	MG/L	Milligrams per Liter	239.2	EPA Standard Method for Dissolved Lead		
NI_D	Dissolved Nickel	MG/L	Milligrams per Liter	249.2	EPA Standard Method for Dissolved Nickel		
ZN_D	Dissolved Zinc	MG/L	Milligrams per Liter	289.2	EPA Standard Method for Dissolved Zinc		
AS_T	Total Arsenic	MG/L	Milligrams per Liter	206.2	EPA Standard Method for Totall Arsenic		
CD_T	Total Cadmium	MG/L	Milligrams per Liter	213.2	EPA Standard Method for Total Cadmium		
CR_T	Total Chromium	MG/L	Milligrams per Liter	218.2	EPA Standard Method for Total Chromium		
CU_T	Total Copper	MG/L	Milligrams per Liter	220.2	EPA Standard Method for Total Copper		
HG_T	Total Mercury	MG/L	Milligrams per Liter	245.1	EPA Standard Method for Total Mercury		
PB_T	Total Lead	MG/L	Milligrams per Liter	239.2	EPA Standard Method for Total Lead		
NI_T	Total Nickel	MG/L	Milligrams per Liter	249.2	EPA Standard Method for Total Nickel		
ZN_T	Total Zinc	MG/L	Milligrams per Liter	289.2	EPA Standard Method for Total Zinc		

Table A.4
Data Sample Types and Sample Identification Type and Number

		SAMPLE_ID (BBSSYMMDDHHmmT##)
SAM_TYP	**DESCRIPTION**	**T##**
GRAB	Discrete Grab Sample	G##
AUTO	Discrete Automatic Sample	A##
EC	Event Composite Sample	EC#
QCFD	Field Duplicate QC Sample	A81 or G81, Auto or Grab respectively
QCMS	Matrix Spike QC Sample	A82 or G82, Auto or Grab respectively
QCMSD	Matrix Spike Duplicate QC Sample	A83 or G83, Auto or Grab respectively
QCABB	Automatic Bottle Blank QC Sample	A84 or G84, Auto or Grab respectively
QCTB	Trip Blank QC Sample	A85 or G85, Auto or Grab respectively
QCFB	Field Blank QC Sample	A86 or G86, Auto or Grab respectively
QCSS	Split Sample QC Sample	A87 or G87, Auto or Grab respectively
QCMB	Method Blank QC Sample	A88 or G88, Auto or Grab respectively
EP	Event Partial Sample (incomplete event coverage)	EP#

Table A.5
Raw and Final Data Flags

RAW FLAGS

FLAG	DESCRIPTION
ND	Non-detect
BDL	Below detectable limits - less than the method lower detection limit
NSQ	Not sufficient quantity
LAC	Laboratory accident
ISP	Improper sample preservation
MI	Matrix interference
HT	Holding time (exceeded)
CAL	Calculated result
EST	Estimated value
CAN	Cancelled
FAC	Field accident
LTL	Less than lower detection limit - less than the lowest dilution prepared
GTL	Greater than upper detection limit - greater than the highest dilution prepared
GDL	Greater than detection limit - greater than the method upper detection limit

FINAL FLAGS

FLAG	DESCRIPTION
NONE	No flag
J	Questionable, problem but not severe enough to reject
R	Rejected
NDJ	Questionable plus estimated not detect
P	Failed logical check
NR	Not reliable

Table A.6
Organizations and Laboratories

LAB	DESCRIPTION
AC	Acacia Basin
A&B	AB
AAC	AAC Trinity
ASCI	ASCI
BAI	Brighton Analytical, Inc.
BR	Birmingham Basin
BV	Bloomfield Village Basin
CAL	Canton Analytical Laboratory
CDM/RPO	Camp Dresser and McKee
DH	Dearborn Heights Basin
EAGLE	EAGLE
ENC	Encotec
ENSR	ENSR
ERG	Environmental Research Group, Inc.
HRC	Hubbell, Roth and Clark
HS	Hubbell-Southfield Basin
HVL	Huron Valley Laboratory
IN	Inkster Basin
KEMRON	Kemron
MEG	Matrix Environmental Group, Inc.
MPS	McNamee, Porter & Seeley, Inc.
PF	Puritan-Fenkell Basin
RF	Redford Basin
RR	River Rouge Basin
SEL	SEL
SM	Seven Mile Basin
UNKNOWN	Unknown Lab
UOFM	UM_SPH
WCDPW	Wayne County Division of Public Works
WLN	Walled Lake - Novi Treatment Plant Laboratory

Table A.7
Event Summary Report
Data Parameters and Units

PARAM_ID	PARAM_ID DESCRIPTION	UNITS	UNITS DESCRIPTION
EVENT_RAIN	Event total rainfall volume determined by basin operator / engineer to be associated with the event	IN	Inches
EVENT_15MINPEAK	Event rainfall 15 minute peak volume	IN	Inches
EVENT_VOLUME	Total volume of water which has flowed past a given location for a specific event	MGAL	Million Gallons
EVENT_DURATION	Total duration of period(s) when flow occurred at a given location during a given event. For influent and effluent locations only. (Example: if basin inflow occurred for 3 hours, then stopped for several hours, and then inflow occurred for 2 more hours, the reported inflow duration would be 05:00.)	HH:MM	Hours:Minutes
EVENT_CBOD_LOAD	Total pollutant load which has flowed past a given location for a given event. Influent and effluent locations only.	LB	Pounds
EVENT_TSS_LOAD			
EVENT_NH3_LOAD			
EVENT_TOTAL_PHOS_LOAD			

Table A.8
Sample Pump Operation Log

Redford CSO Basin				
Dewatering Pump Operation Log*				
March 1998				
PUMP NO.	ACTION	DATE	TIME	
3	START	3/12/98	14:55	
2	START	3/12/98	15:30	
2	STOP	3/13/98	0:25	
4	START	3/13/98	0:30	
4	STOP	3/13/98	1:30	
3	STOP	3/13/98	2:00	

*To be supplied for influent, effluent, dewatering and decanting pumps as applicable.

APPENDIX B

Water Environment Federation
WEFTEC'99
New Orleans, LA

LESSONS LEARNED FROM OPERATION AND MAINTENANCE OF COMBINED SEWER OVERFLOW DETENTION BASINS

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ABSTRACT

In Southeast Michigan, the recognition of combined sewer overflows as a major problem prompted the institution of the Rouge River National Wet Weather Demonstration Program. This program includes the construction of nine CSO detention basins of varying sizes and design. Collection and analysis of flow rates, water quality parameters and operation and maintenance information is still ongoing. One of these basins, the Inkster CSO basin has been in operation since December 1996.

This paper will concentrate on the lessons learned about CSO facilities during the data collection phase of the demonstration program. The focus of the paper is on design and operational issues encountered during the evaluation program

KEYWORDS

Combined sewer overflow, in-system storage, first flush

INTRODUCTION

Combined Sewer Overflows (CSOs) have been identified as major sources of pollution in the United States. In Southeast Michigan, the recognition of this problem prompted the institution of the Rouge River National Wet Weather Demonstration Program. As part of this program, CSO control facilities of varying sizes and design have been constructed to provide treatment of CSO discharges along the Rouge River (see Figure 1, RPO 1996). One of these basins, the Inkster CSO Detention Basin, has been in operation since December 1996.

An intensive monitoring program was negotiated with the Michigan Department of Environmental Quality (MDEQ) and the Rouge Program Office (RPO) to collect influent and effluent water quality parameters to be used in determining the performance of the CSO basins. This paper will concentrate on the lessons learned about CSO facilities during the data collection phase of the demonstration program including facility design considerations, facility operations and preliminary observations.

PROJECT BACKGROUND

The Inkster CSO Detention Basin is a 3.1 MG CSO detention basin serving a combined sewer tributary area of 833 acres and separate area of 308 acres (see Table 1.) The NPDES permit required sizing the CSO facility to provide a 20minute hydraulic detention time for the peak flow rate from a 1 -year/1 -hour storm event. The facility was constructed with an additional 1.1 MG compartment to completely capture the first flush of a storm event. A collector sewer transports flow in excess of the regulator capacity from 10 regulators into the influent pump station wetwell. To prevent basement flooding, the influent pump station and screens were sized to transport the maximum surcharge capacity of the existing combined sewer outfalls. This resulted in a 500 cfs pump station, which is the peak flow resulting from a 10-year/24-hr. storm event on the tributary combined sewer area. The CSO is pumped first into the first flush compartment, then through two parallel flow-through compartments (see Figure 2.) Treated CSO flow in excess of the capacity of the compartments is discharged to the Rouge River. CSO flow captured in the compartments is dewatered back to the interceptor at the conclusion of the storm event. This portion of the flow is transported to the City of Detroit's Wastewater Treatment Plant.

Disinfection is accomplished through the addition of sodium hypochlorite. There are three possible locations where sodium hypochlorite can be injected into the flow stream. At the influent wetwell, CSO pump discharge and at the effluent trough. The primary mode of operation called for flow paced sodium hypochlorite injection in the pump station wetwell.

FACILITY DESIGN CONSIDERATIONS

The upstream collector sewers and influent pump station wetwell provides significant storage capacity, in addition to the capacity provided by the detention basin compartments. This capacity was discounted as not being important during the design stage of the facility. Operational experience has demonstrated that the 1.1 MG storage capacity provided prior to the basin compartments completely captures the CSO generated by a significant number of small size storm events. Between June 1997 and April 1999, 35 of 81 storm events were captured by the storage capacity in the collector sewers and the pump station wetwell.

The use of a f i rst flush tank has proven to be an excellent facility design consideration based on data evaluation and anecdotal information. In addition, review of the total suspended solids (TSS) data collected during the program shows a distinct first flush prof ile (see Figu re 3.) After storm events, the f i rst f lush captu re compartment requires more effort to clean than the other two flow-through compartments.

The design flow for the CSO basin is based on 20-minute detention of 1 -year, 1 -hour flows. This results in a peak flow rate of 228 cfs. However, to eliminate the possibility of basement flooding due to the construction of the basin required a peak flow rate of 500 cfs. During the design phase of the project, the IVIDEQ's policy required that all flows should pass through the CSO basins. This resulted in the need to size screens, chemical feed pumps and flow meters to span a range of flows from 0-500 cfs. This proved to be a large range for the flow meter, especially during low flows and affected flow pacing of chemical feed.

During actual operation, 72 of 81 CSO events generated peak flow rates that were less than 95 cfs. Consequently, a staged pumping scheme should be considered. A smaller set of pumps in the 30 cfs to 60 cfs range to handle the typical storm events, with additional larger pumps for the infrequent but severe storm events.

Regulatory requirements during the design phase also led to the installation of odor control scrubbers. To date, these scrubbers have not been used.

FACILITIES OPERATIONS

Design engineers have paid lip service to the involvement of operation and maintenance during facility design. Typically, this involvement is in the form of sending plan sets to O&M personnel to review prior to final design. The design of the Inkster CSO Basin benefited from the inclusion of the CSO O&M Manager as part of the Value Engineering Team. It also benefited because the manager was able to have input on equipment recommendations, as well as being involved in the construction phase of the project.

Another issue is that in some cases, even if O&M personnel are involved in the design, they may not be involved in subsequent construction phase decisions. Sometimes these decisions involve the elimination of seemingly inconsequential pieces of equipment such as slop sinks, sample preparation table or changes in types of equipment.

Some of the issues encountered during facility operations include the need to provide a dedicated crew for operation and maintenance of these facilities. The maintenance personnel should be involved at the onset of the basis of design and final design. It is also important to include the operating personnel during any Value Engineering that is done for the facility. Usually, operations personnel suggestions may not survive the VE and construction stage of the project.

Most of the operational issues encountered during the operation of the basin have centered on the influent flow meter and Sodium Hypochlorite feed system.

Influent Flow Meter

The influent flow meters for the basin are Accusonics Multipath flow meters. The meters are located immediately upstream of the influent pump station wet-wells. At the beginning of the evaluation program, the Sodium Hypochlorite feed was flow paced, based on the flow meter measurement. The following problems were encountered:

- The basin influent pumps on - off sequence affected the accuracy of the flow meter readings. This also affected the CSO volume recorded for each event.
- The meter inaccuracy made it difficult to flow pace sodium hypochlorite.

The CSO volume estimation has been accomplished with the help of level measurements in the influent sewer and basin compartments, as well as pump run times and effluent Parshall flume measurements.

The hypochlorite feed was changed and paced to influent pump flow, such that the Hypochlorite feed would not start until the CSO pumps start.

Sodium Hypochlorite Feed System

The design of the disinfection system called for storage of enough sodium hypochlorite to disinfect , at peak dosage rates, CSO resulting from back-to-back 1-year, 1 -hour storms.

- During one of the events, the City of Inkster's CSO basin ran out of bleach. This was due to the length of the event.

- The degradation in the strength of the Sodium Hypochlorite, due to initial dilution and length of storage. Sodium hypochlorite concentration will drop during extended storage from 6% to about 3%. This affects the bacteria kill. Provide the ability to modify disinfectant dose based on measured solution strength.

- Problems with Hypochlorite feed pumps.

- Selection of adequate Hypochlorite feed to achieve required fecal coliform kill and TRC less than 1 mg/l.

The lessons learned in the operation of the CSO basin result primarily from trying to solve the above problems.

- There is a need to establish a minimum amount of hypochlorite feed available. This minimum amount should be increased in the winter (December to April). The winter events tend to last longer than events from spring/summer, increasing the chance of a back-to-back event. It also increases the likelihood of running out of disinfectant.

- There is a need to build a sufficient database to aid in reducing hypochlorite feed during an event. This database will help in maintaining effluent TRC concentrations at a reasonable level and achieve the required kill.

- There is a need to set up monthly testing of the stored hypochlorite, as well as testing after delivery and dilution. The test results should be used in selecting the feed rate, as well as deciding when to re-order chemical.

The design of this facility anticipated that most of the basin operations would take place under inclement weather. These conditions include power outages, non-functional telephone lines, and poor road conditions. It is imperative that extensive backup systems be provided to ensure the protection of public health. The design should also realize that some of these issues though minor lasts for as long as the facility is used.

PRELIMINARY OBSERVATIONS

Other findings related to the treatment of CSO discharges are summarized below:

The influent flow rate to the CSO facility is much less than the design flows. Typical influent flow rates of 50 cfs are common, compared with design flows of 200 cfs. About 15% of the storms monitored approached a peak CSO event flow rate of 125 cfs.

- The use of an influent pump station masked the presence of a first flush effect for CBOD5. The first flush effect was clearly observed for TSS.
- A significant portion of the pollutant load removal by the facility is accomplished through CSO volume capture, as opposed to settling during flow-through treatment (see Table 2.)
- Difficulty in achieving a completely remotely controlled CSO facility. Part of the reason is the need to collect grab samples for DO, pH, fecal coliform and TRC. In addition, there is always the possibility of equipment break down during the events.
- Frequency of operation is important, because it allows adequate use of equipment. The more frequently operated basins typically get the most attention. There is also a sense of urgency in the repair of malfunctioning equipment.

CONCLUSION

The lessons learned from the Rouge River National Demonstration Project extends beyond the treatment efficiency of the CSO detention basins. The findings presented in this paper will be useful to designers and operators considering CSO Control facilities. These types of operational experiences are not usually publicized; it is our hope that designers will find it useful.

Table 1. CSO Basin and Tributary Area Characteristics

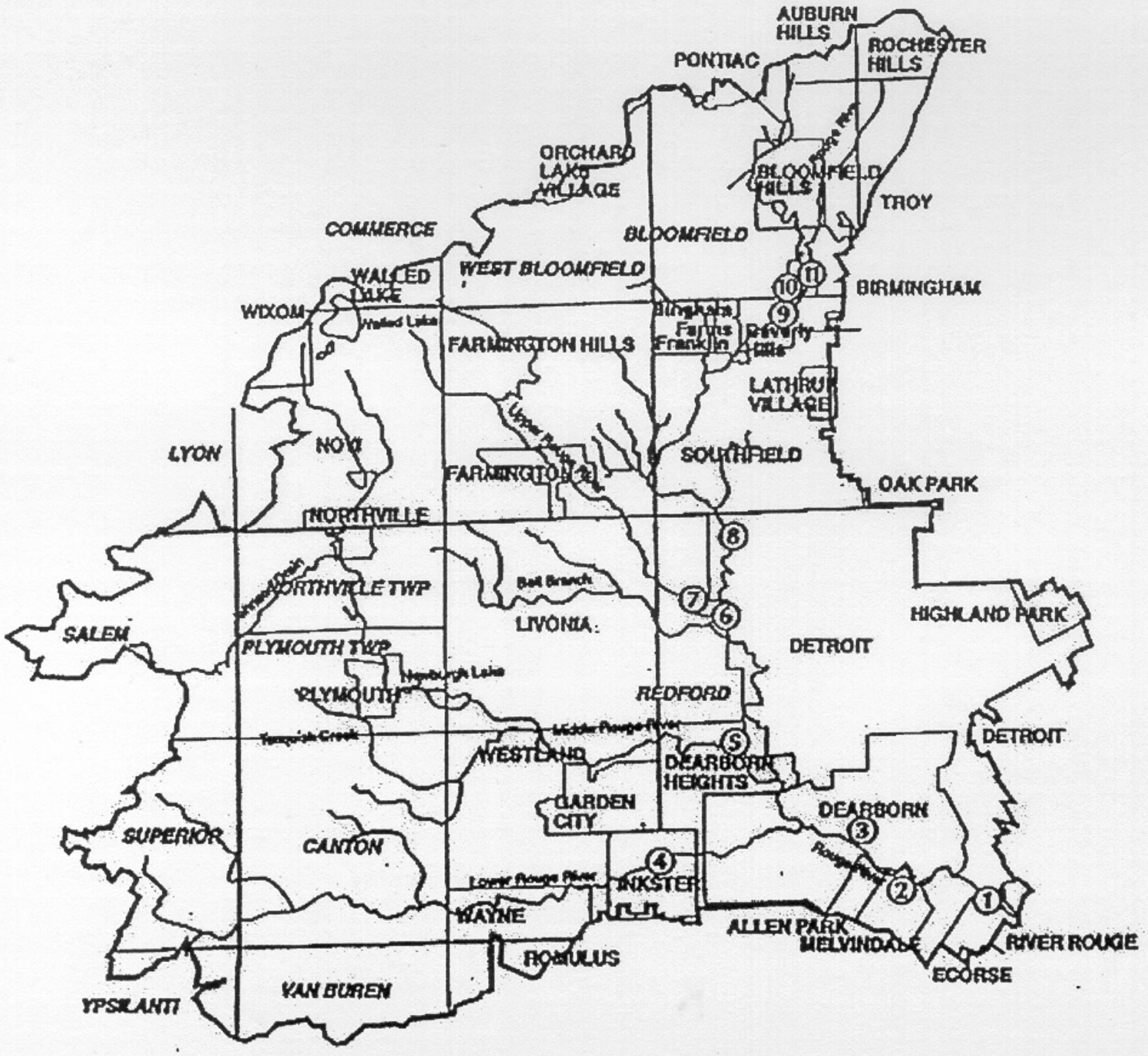
		Inkster
Basis of Design	Design Storm	1 Yr, I Hr
	Rainfall	1.00 in
	Detention Time	20 Minutes
Basin Characteristics	CSO Flow Rate (Design Storm)	228 CFS (0.27 CFS/Acre)
	Basin Volume	2.0 + 1.1 MG
	Wet Well Storage	0.4 MG
	In-System Storage	1.0 MG.
	Innovative Features	1.1 MG First Flush
Tributary Area Characteristics	Combined Area	833 Acres
	Other Tributary Area	308 Acres Storm Water
	Dry Weather Flow	2.6 CFS
	Interceptor Capacity	15.5. CFS (0.019 in/hr)
	Interceptor to DWF Ratio	5.9

Table 2. General Operating Statistics through May 31,1998

		Inkster*
Operating Mode		First Flush Capture, then Flow -Through
Evaluation Period		June 1. 1997 - May 31, 1998
Influent Events	Influent Events	45
	Rainfall Total for Capture	Up to 0.82 in
	Total Volume	103.7 MG
	Total TSS Load	124,000 LBS
	Total CBOD Load	24,200 LBS
Overflow Events	Effluent Events	9
	Total Volume	29.1 MG
	Total TSS Load	23,600 LBS
	Total CBOD Load	2,600 LBS
Percent Influent Capture	Volume	72
	TSS Load	81
	C80135 Load	89

* NOTE:. February 17-21, 1997 Event Not Included for Volume and Load Calculations

Figure 1.



Key to Facilites

1	River Rouge retention basin	7	Redford Township retention basin
2	Dearborn Tunnel	8	Seven Mile retention basin
3	Hubbell-Southfield retention basin	9	Acacia Park retention basin
4	Inkster retention basin	10	Bloomfield Village retention basin
5	Dearborn Heights retention basin	11	Birmingham retention basin
6	Puritan-Fenkall retention basin		

Figure 2.

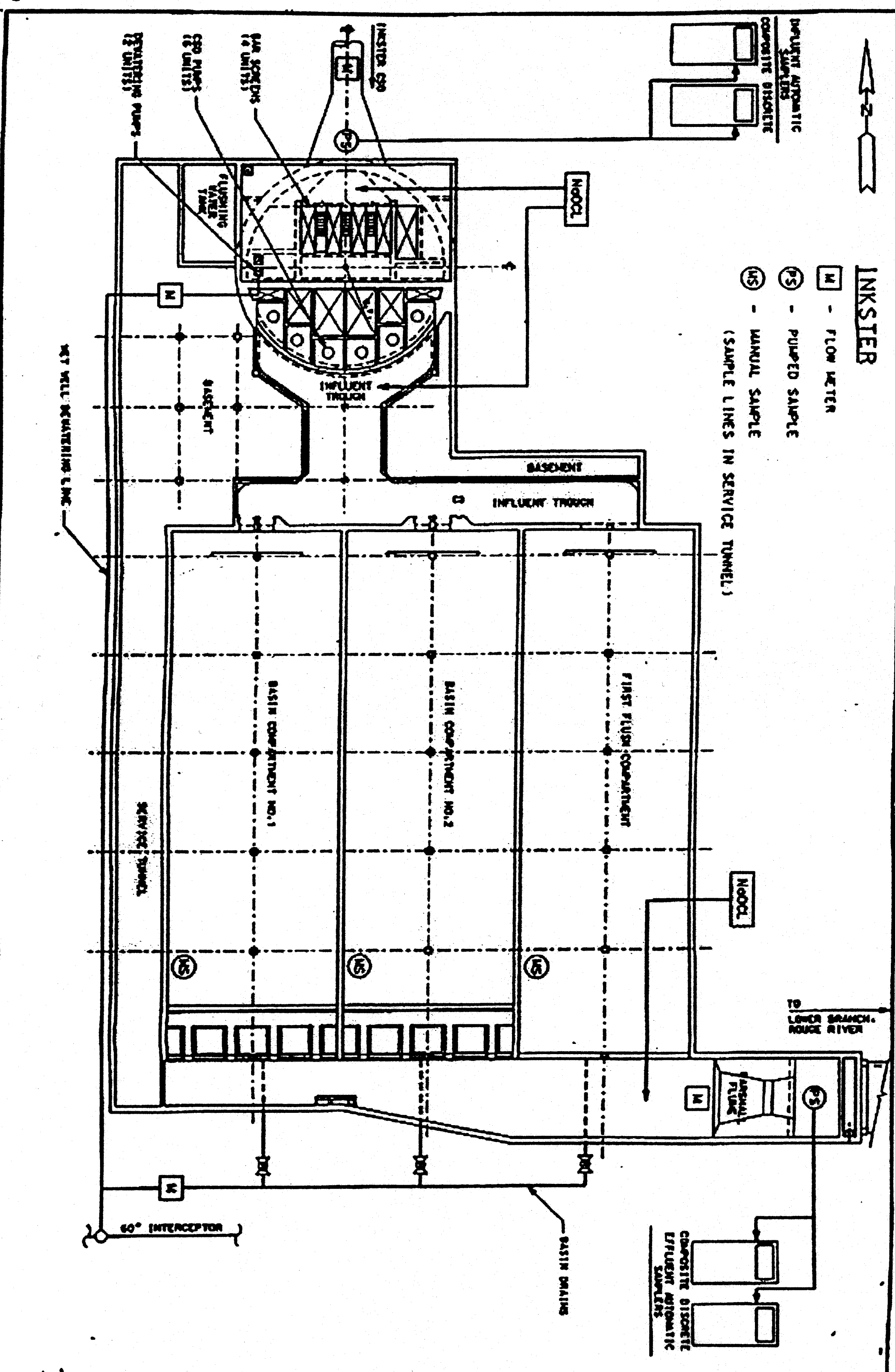

INKSTER
M - FLOW METER
PS - PUMPED SAMPLE
MS - MANUAL SAMPLE
(SAMPLE LINES IN SERVICE TUNNEL)
INFLUENT AUTOMATIC SAMPLERS
COMPOSITE DISCRETE
INKSTER CSO
BAR SCREENS
CSO PUMPS
DEWATERING PUMPS
FLUSHING WATER TANK
NaOCl
INFLUENT TROUGH
BASEMENT
WET WELL DEWATERING LINE
BASIN COMPARTMENT NO.1
BASIN COMPARTMENT NO.2
FIRST FLUSH COMPARTMENT
SERVICE TUNNEL
TO LOWER BRANCH ROUGE RIVER
PARSHALL FLUME
60" INTERCEPTOR
BASIN DRAINS
COMPOSITE DISCRETE
EFFLUENT AUTOMATIC SAMPLERS

Figure 3. Inkster CSO Basin First Flush Profile for Summer Events